Boehmert & Boehmert
J50005PCT
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Amended Claims

1 Transmission spectrometer with a sensor to which, through at least one optical waveguide for emitted radiation, the radiation of at least one radiation source can be introduced, in order to direct it on and/or in an object to be investigated, and with an optical waveguide for detected radiation at a distance from the sensor, through which radiation, which was scattered by, transmitted by and/or emitted by the object to be investigated, especially fluorescent radiation, can be introduced to a radiation detector, which can be connected to an evaluation unit, where
a number of radiation sources are provided, the radiation intensities of each one of which can be adjusted, and which have an emission spectrum which is broadband either per radiation source or for all radiation sources together, and each of which is coupled directly to an optical waveguide for emitted radiation,
the radiation detector detects the entire spectrum of the radiation which is entered in the optical waveguide for detected radiation by diffuse and/or directional reflection, transmission, emission and/or fluorescence, and
in the evaluation unit, as a function of at least one program which can be selected through an operating unit for the calculation of at least one parameter, at least the intensity of one given wavelength can be processed, and the evaluation unit is in working connection with the radiation sources in such a way that, depending on the selected program, the intensity of the radiation emitted from each radiation source can be adjusted individually, especially through the current supplied to the radiation sources and the wavelengths with the corresponding intensities, which arrive from the radiation detector to the evaluation unit, can be selected.

2. Reflection spectrometer with a sensor to which, through at least one optical waveguide for emitted radiation, the radiation of at least one radiation source can be introduced, in order to direct it on and/or in an object to be investigated, and through which, with at least one optical waveguide for detected radiation, radiation, which was scattered by, transmitted by and/or emitted by the object to be investigated, especially fluorescent radiation, can be introduced to a radiation detector, which can be connected to an evaluation unit, whereby at the

free end of the sensor, the radiation coupling-in end of the optical waveguide for detected radiation is surrounded by the radiation coupling-out ends of the optical waveguides for emitted radiation, preferably essentially in a circular manner, so that in the measuring range on and/or in the object to be investigated, there is at least a partial overlap of the aperture of the optical waveguide for detected radiation with the aperture of the optical waveguide for emitted radiation, characterized by the fact that
a number of radiation sources (10-15) are provided, the radiation intensities of each one of which can be adjusted, and which have an emission spectrum which is broadband either per radiation source (10-15) or for all radiation sources (10-15) together, and each of which is coupled directly to an optical waveguide for emitted radiation (20-25),
the radiation detector (30) detects the entire spectrum of the radiation which is entered in the optical waveguide for detected radiation (40) by diffuse and/or directional reflection and/or fluorescence, and
in the evaluation unit (50), as a function of at least one program which can be selected through an operating unit for the calculation of at least one parameter, at least the intensity of one given wavelength can be processed and
the evaluation unit is in working connection with the radiation sources in such a way that, depending on the selected program, the intensity of the radiation emitted from each radiation source can be adjusted individually, especially through the current supplied to the radiation sources and wavelengths with the corresponding intensities, which arrive from the radiation detector to the evaluation unit can be selected.

3. Spectrometer according to Claim 1 or 2, characterized by the fact that the radiation sources are cold light sources and/or semiconductors, preferably in the form of LEDs (10-15) or lasers.

4. Spectrometer according to one of the previous claims, characterized by the fact that the radiation sources (10 – 15) are all emitting equally and in a broad band or at least partly differently and are emitting in a specified spectral region.

5. Spectrometer according to one of Claims 1 to 3, characterized by the fact that at least two radiation sources are emitting in different or not completely overlapping spectral regions, especially with different intensities.

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6. Spectrometer according to Claim 4 or 5, characterized by the fact that the radiation sources include at least one radiation source (10, 13) for emitting red light, at least one radiation source (11, 14) for emitting blue light and at least one radiation source (12, 15) for emitting green light.

7. Spectrometer according to one of the previous claims, characterized by the fact that the radiation detector includes an optical multi-channel detector, especially a CCD detector (3) or a diode array.

8. Spectrometer according to one of the previous claims, characterized by the fact that in the evaluation unit a number of individual spectra can be deposited in a time sequence, especially can be stored, and can be analyzed, especially with consideration of their time sequence.

9. Spectrometer according to Claim 8, characterized by the fact that at least two, especially all, individual spectra can be received at intervals in the range of microseconds to seconds.

10. Spectrometer according to one of the previous claims, characterized by the fact that in the evaluation unit (50) signals from the radiation detector (30) can be resolved into a timewise constant and a timewise changeable, especially pulsating, component for separate evaluation.

11. Spectrometer according to one of the previous claims, characterized by the fact that in the evaluation unit (50) programs are stored for food control, for the determination of oxygen saturation and/or hemoglobin concentration in tissue, for the control of the color, reflection and/or gloss properties of surfaces, dyes and/or paints, for medical analysis, for process analysis and/or for environmental analysis.

12. Spectrometer according to one of the previous claims, characterized by the fact that the sensor is surrounded by an endoscope, the sensor (2) has a housing separate from the radiation sources and the radiation detector and/or the sensor (2) can be handheld.

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13. Spectrometer according to one of the previous claims, characterized by the fact that at least one radiation source can be switched at least for one time period of a measurement in pulsed operation or can be operated with a multiplex pattern.

14. Spectrometer according to Claim 13, characterized by the fact that at least two radiation sources in pulsed operation can be switched or each can be operated with an individual multiplex pattern, where at least two radiation sources are emitting in different or in only partially overlapping spectral regions.

15. Utilization of a transmission spectrometer according to Claim 1, as well as according to Subclaims 3 – 14, as long as these are referring back to Claim 1, for the measurement of the color, turbidity of liquids and/or of the size distribution of particles suspended in fluids, especially in environmental and water analysis or in alcoholic or nonalcoholic beverages.

16. Application of the reflection spectrometer according to Claims 2 to 14 for the detection of the amount of carotenes or dyes in foods or for color control of textiles, cosmetics, adjustments of toupees or for environmental analysis.